

**Title:** Effective aphid management in greenhouse crops by optimizing biological control and nutrient inputs – Progress report

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**Abstract:**

NYS greenhouse growers have reported that aphids are among their greatest pest problems. They are seeking biological control alternatives in part to increasing public pressure to stop using neonicotinoids, the most commonly used insecticide for aphids. Climbing fertilizer prices and potential state legislation regulating nitrogen has increased greenhouse grower interest in reducing fertilizer inputs. Slow release fertilizers (SRF) can reduce nutrient leaching but more work is needed to determine effective application rates for bedding plants and vegetable transplants. The objective of this project is to develop, field-test, and share an integrated pest management approach for managing greenhouse aphids using beneficial insects and reduced fertilizer inputs.

From the first year on-farm trials, we learned several adaptations necessary to the effective use of slow release fertilizers in the production of bedding plants. There were insufficient aphid populations to evaluate aphid response to differences in fertility program. The first year research results showed that aphid numbers appear to be affected by plant size, which is affected by nitrogen level but also by plant species and architecture.

**Background and justification:**

Greenhouse operations are large consumers of pesticides and fertilizers due to intensive production methods and consumer demand for products free of cosmetic damage. Aphids remain among the most troublesome greenhouse pests for ornamental and vegetable producers. The most common greenhouse aphid pests, green peach and foxglove aphids, are among the greatest targets of greenhouse pesticides used. Intense pesticide use leads to problems with resistance, the environment, and worker safety. Nationally, the use of neonicotinoid pesticides (such as imidacloprid, the most common material for aphid control in NYS) is under public scrutiny due to a potential connection with decline in bee populations. Further, the NYS DEC has proposed eliminating the neonicotinoids on Long Island, in part, due to their detection in test wells.

Therefore it is critical to develop, and deliver to growers, effective sustainable alternatives for aphid control. Beneficial insects can be used, but applications must work effectively, reliably, and cheaply. The mix of aphid species in NYS greenhouses has changed dramatically over time with foxglove aphid infestations increasing. Unfortunately the natural enemy that is most cost-effective against green peach aphid is not effective against foxglove aphid. Thus we seek to evaluate a combination of natural enemies as an effective and simple way to control common aphid pests.

It has been estimated that greenhouse operators supply 1,000-2,000 lbs. of N per acre per year (Weiler, 2003). The majority of greenhouse operations do not capture runoff from their operations and therefore the N and P released by conventional water soluble fertilizers (WSF) are a non-point source of pollutants. Draft legislation has recently been circulated in the NYS Senate and Assembly that aims to increase the oversight of N use on Long Island. To respond to increasing fertilizer prices and regulatory pressure, NYS greenhouse producers are interested in voluntarily adopting reduced fertilizer input strategies for growing their crops such as slow release fertilizers (SRF) or reduced rates of WSF. In preliminary work by N. Mattson, SRF reduced N and P leaching of potted chrysanthemums by 5-10 fold vs. WSF controls. However, more work is needed to determine application rates for other common bedding plants and vegetable transplants. Plant fertility also affects aphid populations. High WSF applications promote increased populations and faster population growth of green peach aphids (Jansson, 2003) and cotton aphids (Davies et al, 2004). No work has been done to determine the effect of SRF fertilizers on aphid populations, but we hypothesize that use of SRF will reduce luxury fertilizer consumption by the plant, leading to reduced aphid numbers thereby making biocontrol easier.

### **Objectives:**

The objective of this project is to develop, field-test, and share an IPM approach for managing green peach and foxglove aphids based on biological control and reduced fertilizer inputs.

### **Procedures:**

#### On-farm trials

Six ornamental greenhouses around the state were selected for on-farm trials of types of fertilizer and aphid management. In Year 1, each grower trialed a slow release fertilizer in comparison to their standard fertilization program. The type and rate was determined based on grower choice, crop and production method. In addition, greenhouses were scouted for aphids.

#### Research trials

The first set of research trials was designed to evaluate the effect of several liquid and slow release fertilization programs on the development of green peach and foxglove aphids on pepper and pansy transplants.

Plants were grown from seed for 4-6 weeks with identical fertilizations. They were then transplanted into 4 inch pots and grown under one of the seven fertilizer treatments for 2 weeks. There were 10 replicates of each treatment.

1 - Unfertilized control (water only)

- 2 - Water soluble fertilizer (WSF) low rate  
50 ppm N constant liquid feed
- 3 - Water soluble fertilizer (WSF) high rate  
150 ppm N constant liquid feed
- 4 - Controlled release fertilizer (CRF) low rate  
Osmocote Bloom 12-7-18 (1.75 pounds per cubic yard)
- 5 - Controlled release fertilizer (CRF) high rate  
Osmocote Bloom 12-7-18 (3.5 pounds per cubic yard)
- 6 - Organic granular fertilizer (OGF) low rate  
Verdanta EcoVita 7-5-10 (3 pounds per cubic yard)
- 7 - Organic granular fertilizer (OGF) high rate  
Verdanta EcoVita 7-5-10 (6 pounds per cubic yard)

Three adult female aphids of either green peach or foxglove were applied to each plant and allowed to reproduce for 2 weeks. At the end of that period, the number of aphids was counted. There were 3 repetitions of the pepper trial and 3 of the pansy trial. The first pepper trial was transplanted at 6 weeks and the plants grown with WSF were too large. All successive pepper and pansy trials were transplanted at 4 weeks.

To link fertilization practices with plant nutrient status, shoot (leaf and stem) tissue samples of peppers and pansies were collected from one run of the experiment. For each fertilizer treatment, there were three replicate samples (each replicate consisted of pooled tissue from three individual plants). Tissue analysis was conducted at the Cornell Nutrient Analysis Laboratory.

## **Results and discussion:**

### On-farm trials

Trials were conducted at 6 commercial cooperators in Spring 2015. The objectives were to determine the effect of controlled release fertilizer (CRF) or organic slow release fertilizer (OSRF) as compared to a constant liquid fertilizer (CLF) on plant quality and aphid populations. Based on previous work CRF/OSRF can significantly reduce leaching of nutrients compared to CLF as well as reduce labor for mixing fertilizer solutions and maintaining a fertilizer injector. However more work is needed to demonstrate that CRF/OSRF can grow high quality crops matching CLF in commercial greenhouses (which have variable crops and greenhouse environmental conditions as compared to on-campus trials).

Regarding plant quality of CRF/OSRF vs. CLF:

**Genrich's** Osmocote Bloom CRF was compared to their standard CLF fertilizer regime for pansies growing in 6-packs. When observed at the end of the plant growth cycle, there were no significant differences in plant quality (plant height, width, and flower number) as compared to CLF. Therefore, CRF could successfully replace CLF for pansies. No aphids were observed in any of the pansy plants regardless of fertilizer treatment.

**Bakers Acres** Verdanta EcoVita 7-5-10, a granular OSRF, was compared to standard CLF fertilizer regime for pepper transplants grown in packs. Plant growth with OSRF was much reduced compared to CLF and the problem seemed to arise from elevated salts and pH from the

OSRF. The elevated salts also appeared to make the plants more susceptible to root borne pathogens. The issue may have arisen from too high an application rate or uneven incorporation into the potting mix prior to transplanting. More experiments are needed with pepper and the application rate of OSRF before this can be recommended as a replacement for CLF. Although aphids were found on sticky cards used as part of scouting, no aphids were found on pepper transplants of any fertilizer treatment.

**Amos Zittel and Sons** Osmocote Bloom CRF was compared to their standard CLF fertilizer regime for peppers growing in 6-packs. There was no significant difference in plant size (height and width) comparing the CRF vs. CLF plants. However, it was observed that the CRF plants were more variable in size, while CLF plants were more consistent in size and color. Therefore, CRF may work fine, in general, for growth of pepper transplants but care must be taken to ensure uniformity of mixing the fertilizer material prior to transplanting, especially when plants are grown in small cell-size containers. In addition, smaller size CRF granules may be preferable for small container sizes to ensure uniformity of mixing. No aphids were observed in experimental plants.

**Zerillo Gardens** Osmocote Bloom CRF was compared to their standard CLF fertilizer regime for pansies growing in 6-packs. Plant quality of CRF was greater as compared to the CLF counterparts in terms of plant size (height) and number of open flowers. However, it should be noted that CRF and CLF plants were grown in separate greenhouses. Therefore there is evidence that CRF produced higher quality plants however this affect cannot be separated from impact of greenhouse environment. No aphids were observed in experimental plants.

**Lockwood's** Osmocote Bloom CRF was compared to their standard CLF fertilizer regime for Calibrachoa growing in pots. No significant difference in plant quality was observed in response to fertilizer treatment. However, much of the crop (regardless of fertilizer treatment) succumbed to Thielaviopsis root-rot and was unmarketable. No aphids were observed on experimental plants regardless of fertilizer treatment.

**Gabrielsen Farms** Osmocote Bloom CRF was compared to their standard CLF fertilizer regime for Ipomoea (sweet potato vines) growing in pots. Data analysis is still in process.

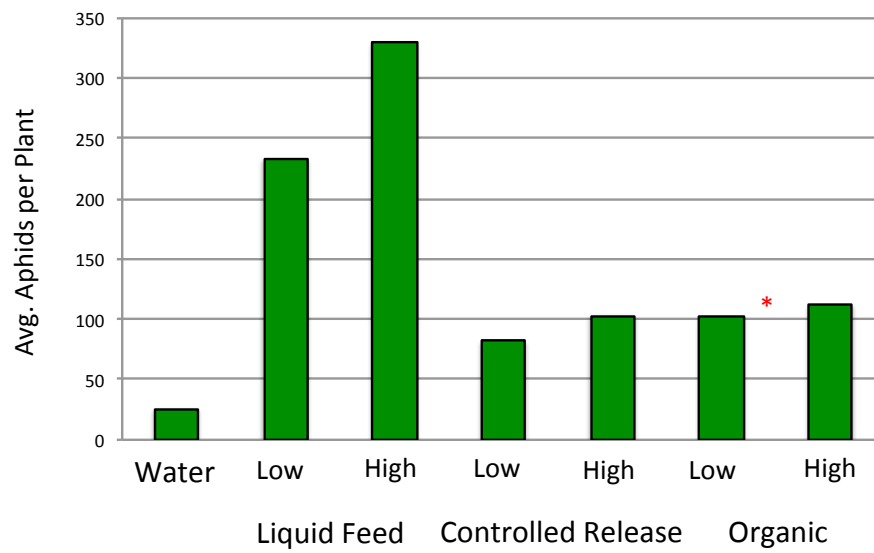
In summary, CRF applied at a medium label rate could be successfully used to grow pansies of equal quality to CLF. Regarding peppers, OSRF (at a medium label rate) could not be successfully used as a CLF replacement. Therefore, for certified organic vegetable transplant selection more work is needed to determine a suitable fertilizer material/rate to replace a conventional CLF. Further our results demonstrate that when CRF/OSRF are applied by incorporating into the potting mix prior to transplant that care must be taken to distribute the fertilizer uniformly so that each cell/container has about the same amount of fertilizer. Use of smaller granule size may improve the issue with uniformity for growing in small cell-packs.

#### Research trials

For both aphid species on pepper, the greatest number of aphids was found on the two liquid feed treatments. The higher rate resulted in significantly more aphids than the lower rate. Aphid

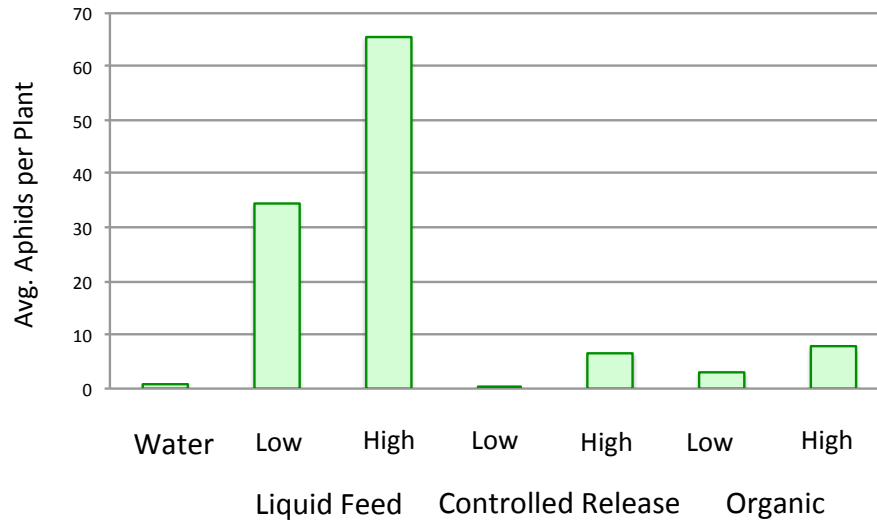
numbers on low and high rates of the controlled release and organic fertilizers were not different from each other. In all cases, the number of green peach aphids was 5 or more times that of the number of foxglove aphids for each fertilizer treatment. Nitrogen content of pepper transplants mirrored the number of aphids by fertilizer type and rate, as did the size of the plants.

Avg. green peach aphids per plant on peppers grown with one of seven fertilizer treatments – Second Experiment



Transplanted at 4 weeks  
Repeated once more – similar results

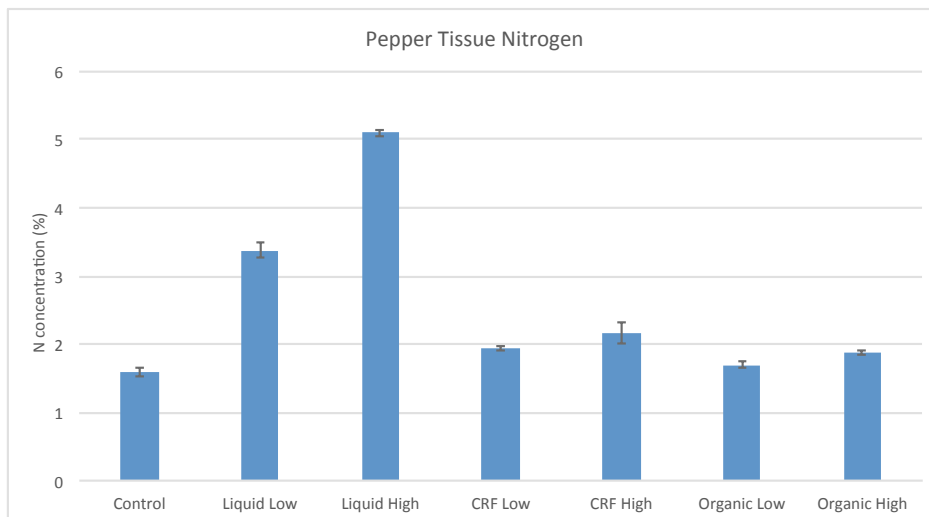
Avg. foxglove aphids per plant on peppers grown with one of seven fertilizer treatments – Second Experiment



3 Runs – all similar results

## Plant tissue analysis - pepper

Note: This measures N in tissue. Why does this matter?



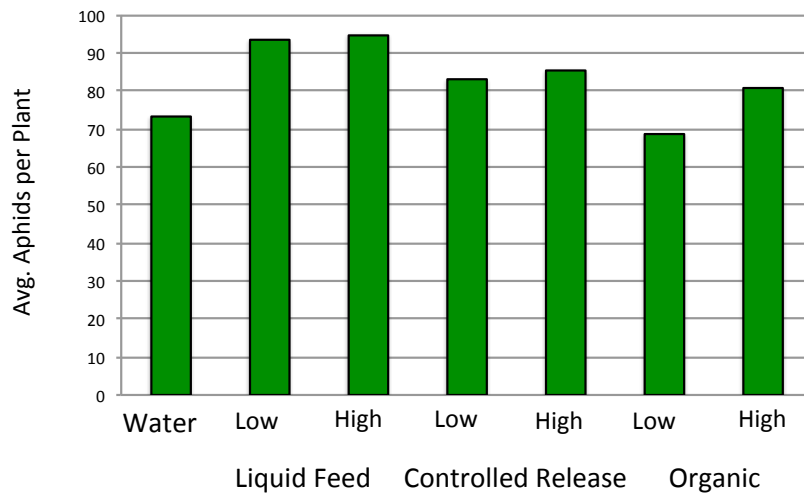
## Peppers after 4 weeks of Fertilizer Treatments



Water      Low      High      Low      High      Low      High  
Liquid Feed      Controlled Release      Organic

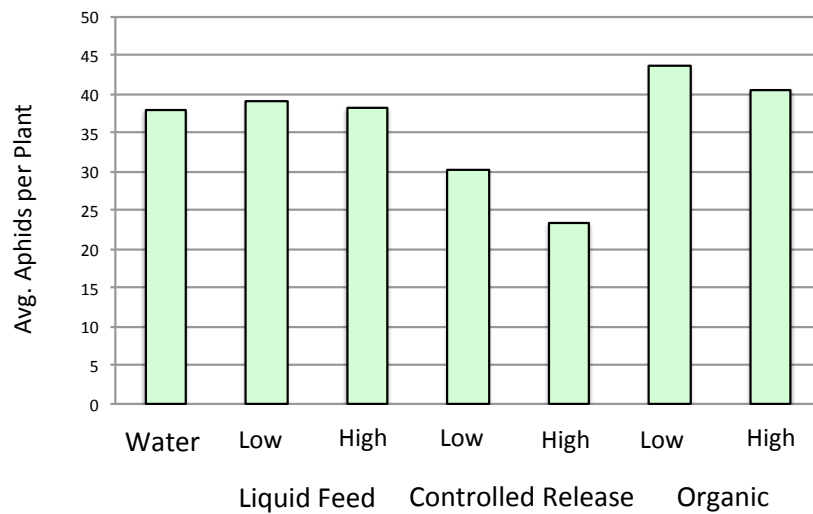
However, with pansy transplants, the number of aphids did not vary significantly by fertilizer type or rate. While the pattern of nitrogen rate in the tissue mirrored that in the pepper transplants, the differences in plant size were much less pronounced, perhaps because pansy is a rosette plant.

Avg. green peach aphids per plant on pansies grown with one of seven fertilizer treatments – First Experiment

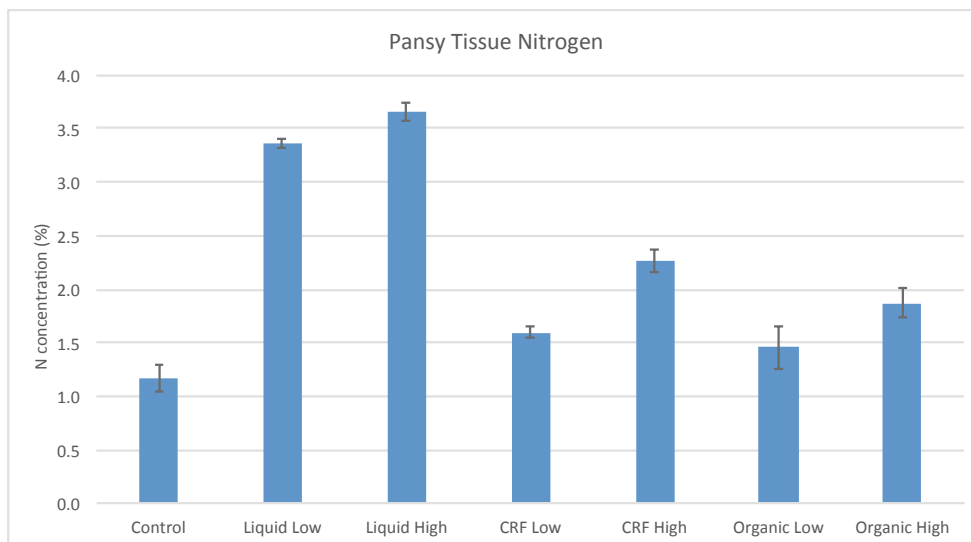




Avg. foxglove aphids per plant on pansies grown with one of seven fertilizer treatments – First Experiment



## Plant tissue analysis - pansy



## Pansies after 4 weeks of Fertilizer Treatments



High Low High Low High Low Water  
Organic Controlled Release Liquid Feed

(Note: Treatments 1-7 are right to left in this photo)

Further experiments will be run to evaluate plant size versus tissue nitrogen content as the determining factor in aphid population development for the 2 aphid species and the 2 plant species.

Relative to the objectives, however, it does appear that the use of slow release fertilizers led to smaller aphid populations on both plant species.

### **Project locations:**

On farm trials – Riverhead, Buffalo, Ithaca, Rochester, Syracuse, NY

Research trials – Ithaca, NY